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CONTENTS.

NEW METHOD OF PROTECTING BUILDINGS FROM LIGHTNING.

SPARE THE ROD AND SPOIL THE HOUSE!

Lightning Destroys. Shall it be Your House or a Pound of Copper?

PROTECTION FROM LIGHTNING.

What is the Problem?

IN seeking a means of protection from lightning-discharges, we have in view two objects,—the one the prevention of damage to buildings, and the other the prevention of injury to life. In order to destroy a building in whole or in part, it is necessary that work should be done; that is, as physicists express it, energy is required. Just before the lightning-discharge takes place, the energy capable of doing the damage which we seek to prevent exists in the column of air extending from the cloud to the earth in some form that makes it capable of appearing as what we call electricity. We will therefore call it electrical energy. What this electrical energy is, it is not necessary for us to consider in this place; but that it exists there can be no doubt, as it manifests itself in the destruction of buildings. The problem that we have to deal with, therefore, is the conversion of this energy into some other form, and the accomplishment of this in such a way as shall result in the least injury to property and life.

Why Have the Old Rods Failed?

When lightning-rods were first proposed, the science of energetics was entirely undeveloped; that is to say, in the middle of the last century scientific men had not come to recognize the fact that the different forms of energy—heat, electricity, mechanical power, etc.—were convertible one into the other, and that each could produce just so much of each of the other forms, and no more. The doctrine of the conservation and correlation of energy was first clearly worked out in the early part of this century. There were, however, some facts known in regard to electricity a hundred and forty years ago; and among these were the attracting power of points for an electric spark, and the conducting power of metals. Lightning-rods were therefore introduced with the idea that the electricity existing in the lightning-discharge could be conveyed around the building which it was proposed to protect, and that the building would thus be saved.

The question as to dissipation of the energy involved was entirely ignored, naturally; and from that time to this, in spite of the best endeavors of those interested, lightning-rods constructed in accordance with Franklin's principle have not furnished satisfactory protection. The reason for this is apparent when it is considered that the electrical energy existing in the atmosphere before the discharge, or, more exactly, in the column of dielectric from the cloud to the earth, above referred to, reaches its maximum value on the surface of the conductors that chance to be within the column of dielectric; so that the greatest display of energy will be on the surface of the very lightning-rods that were meant to protect, and damage results, as so often proves to be the case.

It will be understood, of course, that this display of energy on the surface of the old lightning-rods is aided by their being more or less insulated from the earth, but in any event the very existence of such a mass of metal as an old lightning-rod can only tend to produce a disastrous dissipation of electrical energy upon its surface,—"to draw the lightning," as it is so commonly put.

Is there a Better Means of Protection?

Having cleared our minds, therefore, of any idea of conducting electricity, and keeping clearly in view the fact that in providing protection against lightning we must furnish some means by which the electrical energy may be harmlessly dissipated, the question arises, "Can an improved form be given to the rod so that it shall a[illegible] in this dissipation?"

As the electrical energy involved manifests itself on the surface of conductors, the improved rod should be metallic; but, instead of making a large rod, suppose that we make it comparatively small in size, so that the total amount of metal running from the top of the house to some point a little below the foundations shall not exceed one pound. Suppose, again, that we introduce numerous insulating joints in this rod. We shall then have a rod that experience shows will be readily destroyed—will be readily dissipated—when a discharge takes place; and it will be evident, that, so far as the electrical energy is consumed in doing this, there will be the less to do other damage.

The only point that remains to be proved as to the utility of such a rod is to show that the dissipation of such a conductor does not tend to injure other bodies in its immediate vicinity. On this point I can only say that I have found no case where such a conductor (for instance, a bell wire) has been dissipated, even if resting against a plastered wall, where there has been any material damage done to surrounding objects.

Of course, it is readily understood that such an explosion cannot take place in a confined space without the rupture of the walls (the wire cannot be boarded over); but in every case that I have found recorded this dissipation takes place just as gunpowder burns when spread on a board. The objects against which the conductor rests may be stained, but they are not shattered.

I would therefore make clear this distinction between the action of electrical energy when dissipated on the surface of a large conductor and when dissipated on the surface of a comparatively small or easily dissipated conductor. When dissipated on the surface of a large conductor,—a conductor so strong as to resist the explosive effect,—damage results to objects around. When dissipated on the surface of a small conductor, the conductor goes, but the other objects around are saved

A Typical Case of the Action of a Small Conductor.

Franklin, in a letter to Collinson read before the London Royal Society, Dec. 18, 1755, describing the partial destruction by lightning of a church-tower at Newbury, Mass., wrote, "Near the bell was fixed an iron hammer to strike the hours; and from the tail of the hammer a wire went down through a small gimlet-hole in the floor that the bell stood upon, and through a second floor in like manner; then horizontally under and near the plastered ceiling of that second floor, till it came near a plastered wall; then down by the side of that wall to a clock, which stood about twenty feet below the bell. The wire was not bigger than a common knitting needle. The spire was split all to pieces by the lightning, and the parts flung in all directions over the square in which the church stood, so that nothing remained above the bell. The lightning passed between the hammer and the clock in the above-mentioned wire, without hurting either of the floors, or having any effect upon them (except making the gimlet-holes, through which the wire passed, a little bigger), and without hurting the plastered wall, or any part of the building, so far as the aforesaid wire and the pendulum-wire of the clock extended; which latter wire was about the thickness of a goose-quill. From the end of the pendulum, down quite to the ground, the building was exceedingly rent and damaged. . . . No part of the aforementioned long, small wire, between the clock and the hammer, could be found, except about two inches that hung to the tail of the hammer, and about as much that was fastened to the clock; the rest being exploded, and its particles dissipated in smoke and air, as gunpowder is by common fire, and had only left a black smutty track on the plastering, three or four inches broad, darkest in the middle, and fainter towards the edges, all along the ceiling, under which it passed, and down the wall."

One hundred feet of the Hodges Patent Lightning Dispeller (made under patents of N. D. C. Hodges, Editor of *Science*) will be mailed, postpaid, to any address, on receipt of five dollars ($5).

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SCIENCE

NEW YORK, OCTOBER 13, 1893.

THE AIR OF LARGE TOWNS.

BY G. H. BAILEY, D.SC., PH.D., THE OWENS COLLEGE, MANCHESTER, ENGLAND.

DURING the past three years a series of investigations have been in progress in England with a view to ascertain the composition of the air in populous districts under varying meteorological conditions. The Royal Society, the Royal Horticultural Society and the Manchester Field Naturalists have assisted the work by grants towards the cost of the requisite apparatus, and your readers may be interested in the results which have been obtained, although, of course, it is only possible to give a very brief summary of them. General experience has shown that evergreens cannot be grown in the heart of our larger cities and even the more hardy deciduous trees make little progress and sooner or later succumb. The sulphurous and other noxious vapors and the deposits of soot, hydrocarbons, etc., which form on the leaves are the chief agents in the destruction of plant-life.

Moreover, during periods of fog, when the air is surcharged with such impurities, the amount of sickness and the death-rate increase very considerably, especially in regard to diseases of the respiratory organs. The death-rate indeed from such diseases after foggy weather frequently increases to three-fold its normal value and is always exceptionally high in the densely populated districts.

Seeing that very few analyses of town air have been made embracing impurities such as sulphur in its various combinations and organic matter, attention was particularly devoted to these. And, indeed, setting aside the import of such forms of pollution from a sanitary point of view, the variations in sulphur compounds and organic matter may well be taken as means of differentiating between town and country air and of comparing together the condition of the atmosphere in different districts of a town. The method of procedure was to establish in London, Liverpool and Manchester and their suburbs a number of observing stations where determinations were periodically made of the composition of the air, of the character of the rain and snow and of the intensity of light. Comparative measurements were also at times made in country districts and in parts (such as Switzerland) where the air is of a great degree of purity.

From a very large number of observations I may summarize as follows:

(1) Country air and the air of the less populous parts of towns under the most favorable conditions show an amount of sulphur existing as sulphurous and sulphuric acid, etc., equivalent to not more than one volume of sulphurous acid per ten million volumes of air.

In populous districts this was found to rise to ten volumes *as a general average* in the Winter months and about five in the Summer. During dense fog such as occurs with tolerable frequency during the Winter, the amount recorded has been from thirty to fifty volumes. Whilst, therefore (as already found by previous observers), the carbonic acid gas during foggy weather is only about double that ordinarily occurring, the sulphur compounds accumulate so as to reach from twenty to fifty-fold their normal amount.

(2) Increase of a similar order was found to take place in the suspended organic matter of the air, and not only so, but the increase in amount, especially in closely crowded districts, was associated with a greater virulence.

A critical examination was also made of the nature of the deposits carried down during foggy weather, and as an instance I may give the composition of sample collected at Chelsea (London).

Carbon, - - -	39 per cent.
Hydrocarbons, - - -	12.3 "
Organic bases (pyradines), -	2.0 "
Sulphuric acid, - - -	4.3 "
Hydrochloric acid, - -	1.4 "
Ammonia, - - -	1.4 "
Metallic iron and magnetic oxide,	2.6 "
Other mineral matter, chiefly silica, and ferric oxide, -	31.2 "
Water - - -	not determined.

(3) With regard to the prevalence of black fogs we are fortunate in having records (kept by Dalton) which indicate that in the earlier part of this century, Manchester, with a population at that time of about 120,000, had on an average about four or five dense fogs during the winter, whilst at the present day (with a population of half a million) we have dense fog lasting the whole day on twenty days or more and fogs of less density are experienced on forty or fifty days.

The number and nature of the fogs vary, of course, according to the season, but this may be taken as a general expression of the state of things now.

(4) Measurements of the extent to which the actinic rays are cut off by smoke and haze show that the central areas of our large towns suffer a very large diminution, amounting to a loss of from thirty-five to fifty per cent as compared with the suburbs. That these suburbs are themselves by no means removed from the influence of smoke is evidenced by the fact that under like conditions the values obtained at Torquay and at Grindelwald in Switzerland were three-fold and six-fold, respectively, of those given for the suburbs of London and Manchester. In foggy weather ninety-five per cent or more of the actinic rays are cut off.

(5) Determinations of the number of bacteria and moulds occurring in the air show that again in this respect, also, the contrast between town and country air is very marked indeed, and that in all such determinations due allowance must be made for the meteorological conditions prevailing at the time of experiment. The effect of impurities, such as sulphurous acid on micro-organisms, is also being studied.

Though in the previous paragraphs it has only been possible to deal in the most general manner with the results obtained, the remarks will, I hope, be sufficient to give point to a request that I should like to lay before your readers.

Smoke arising from the combustion of coal is undoubtedly the primary cause of the pollution of town air either directly or indirectly; directly in its contribution of sooty matters, hydrocarbons, sulphurous acid, etc., and indirectly in promoting a condition of the atmosphere in which free diffusion is very much interfered with and leading therefore to the accumulation of sewer gases and emanations from decaying refuse in the lower stratum of air. The substitution of gaseous fuel, though it may not get rid of fogs altogether, will doubtless mitigate in a very large measure their noxious character and in the era-

when lighting is done by electricity and heating by gas the whole aspect of our towns will be changed for the better. We have, however, no wide experience in this country to which to point as an object lesson in such a direction. In the United States gaseous fuel has been much more freely applied, and there are, I understand, instances in which coal has been almost entirely superseded by natural gas. If any of your contributors could say how far this is the case and give some idea of the effect which such a change has produced on the air of the locality and on the aspect of the town in question, a signal service would be rendered and a distinct advance would be made in the direction of banishing the fog demon once and for all.

THE UTICA SHALE IN STEPHENSON COUNTY, ILLINOIS.

BY OSCAR H. HERSHEY, FREEPORT, ILL.

In the various reports of the Illinois Geological Survey all the strata from the top of the Galena Limestone to the base of the Niagara have been classed together under the term Cincinnati Group. So far as northwestern Illinois is concerned this was probably the only classification possible from the limited data at hand. As a general thing only the upper half of the formation was seen in open section, as this is the only part ever quarried into, and natural sections of Cincinnati strata are rare in this region. But a few do exist in the southern and southwestern parts of Stephenson County, which show the lower strata of the shales, and from an examination of these, together with quarries and railway cuttings, the following section has been prepared:

Generalized section of the Cincinnati Group in Stephenson Co., Illinois.

Niagara Limestone.

Light brown, argillaceous, thin-bedded limestone, and white chert. Transition to Niagara, and counted with it. - - - 10 ft.

1. Calcareo-argillaceous shales. Buff and gray, with irregular patches of blue. Generally unfossiliferous. - - - - 50 ft.
2. Light brown, crystalline, dolomite layers, and soft, yellowish shales. Fossils very abundant. - 15 ft.
3. Coarse-grained, calcareo-argillaceous shales. Light brown and red. Dark brown laminated shales alternating with lower layers. No fossils. - 20 ft.
4. Dark brown, argillaceous, finely laminated and very fissile shales. No fossils. - - 5 ft.
5. Same as above, except light brown in color. 3 ft.
6. Stratum containing much reddish-brown powdery iron oxide. - - - - 6 in.
7. Yellow granular shale. - - - - 8 in.
8. Dark brown shales made up largely of comminuted shells. Fossils. - - - 4 ft.

Galena Limestone.

Since the remarkable discovery of oil and natural gas in the Trenton limestone of Ohio and Indiana, and the consequent discovery that the Utica shale of the New York section is present in the two states mentioned as a well-marked bed of dark brown shale, the writer has thought it probable that the Utica shale, *in its normal condition*, would be found to make up a part of the Cincinnati strata of northwestern Illinois.

Many of the "mounds" of western and southern Stephenson County are capped with a few feet of Niagara limestone, but the main body of the elevation is made up of the light colored shales or shaly limestones aggregating fifty feet in thickness, and numbered one in the section. This is certainly not Utica, but agrees pretty well in stratigraphic and lithologic conditions with the Hudson River shales, as developed in southern Ohio. The evidence is still stronger for the Hudson River age of the underlying fifteen feet of light colored shales containing numerous limestone layers, literally covered with fossils, which, so far as I know, are of typical Hudson River species.

The preceding strata are of a generally light color, but in No. 3 dark colors begin to appear. It is probable that wells drilled through the Cincinnati strata in this region would be reported as passing through sixty-five feet of light colored shales, then through twenty feet of gradually darkening beds, and finally about fourteen feet of dark brown shales. This agrees with well-section reports from Ohio, differing, however, in the thickness of the strata.

No. 3 is so coarse-grained as to resemble sandstone, but on dissolving the calcareous matter with acid the grains are found to be composed principally of clay. These gradually grow darker towards the base, and thin strata similar to No. 4 appear, alternating with the red sand-like shales. No. 4 is a very characteristic stratum of non-granular, finely laminated dark brown shale, weathering to a light blue color, and breaking into small flat pieces, as does the Utica shale of the Atlantic slope.

No. 5 is similar in constitution, but is somewhat lighter in color, weathering to buff. The thin stratum containing the bright colored powdery iron oxide appears to be made up largely of dark colored clay, but is not well exposed. The underlying yellow shale is similar to parts of No. 1, containing some irregular patches of blue, and seems out of place among these dark colored shales.

But now we come to the most remarkable of all—a four-foot stratum of dark brown shale, made up largely of fragments of small shells, irregular masses of iron disulphide, small rounded concretions of a slaty color, and dark brown or black mud. Only one variety of shell remains in an unfractured condition, and this is probably some species of Singula. These dark shales lie on a series of buff colored shaly limestones, also largely made up of comminuted shells, but which is undoubtedly the upper portion of the Galena Limestone.

The dark brown shales, Nos. 4 and 8 of the section and included lighter colored strata, are apparently stratigraphically and lithologically similar to the Utica shale as developed in Ohio and Indiana, and although this terrane in the latter state has been shown to thin rapidly towards the west, it is considered quite probable that it does not entirely disappear at least as far west as the region under discussion, viz., Stephenson County, Illinois.

While the lower thirteen or fourteen feet of the so-called Cincinnati shales of this region are considered to be truly of Utica age, the succeeding twenty feet of shales, No. 3 of the section, may be transition strata to the Hudson River shales, which certainly have set in in characteristic form by the time the base of No. 2 is reached.

There is evidence tending to show that some of the beds, especially Nos. 7 and 8, thin out and totally disappear in portions of the field, also that the dark brown laminated shales, No. 4, thin out towards the west and south, and perhaps the entire dark colored portion of the series disappears before reaching the Mississippi River. There seems to be an interesting field for future study in this portion of the Mississippi Valley, and some curious problems to solve.

This preliminary note is published in the hope that sections showing the lower portion of the Cincinnati shales in other counties of this and neighboring states will be reported for comparison in order to determine the boundaries of each distinct formation, and the changes which they undergo in passing from one region to another, which is absolutely necessary for the proper understanding of the early Silurian history of what is now northern Illinois.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

ON THE SYSTEMATIC POSITION OF THE DIPTERA.

BY ALPHEUS S. PACKARD, PROVIDENCE, R. I.

WHILE, on the whole, the classification of the insects has become of late years placed on a more scientific basis, there is still some difference of opinion as to the systematic position of the Diptera, a few authors regarding the order as being the "highest," and entitled to stand at the head of the insect series.

Three important steps in the classification of insects have recently been taken. (1) The higher position given to those orders with a complete metamorphosis over those whose development is direct; no doubt the process of metamorphosis is an adaptive, secondary feature, and one not possessed by the more primitive, "lower" orders, such as the Orthoptera and Hemiptera, not to speak of the Synaptera (Thysanura, Cinura and Collembola). (2) The next great advance was the dismemberment of the Pseudoneuroptera into a number of distinct orders, and the separation of the metamorphic Neuroptera from the ametamorphic orders, with which they were formerly associated. (3) The last step in advance was the recognition of the inferior position of the Coleoptera compared with the Lepidoptera, Diptera, and Hymenoptera, the beetles having been during the first half of this century universally placed at the head of the insect class, for no other reason apparently than that they were the favorites of entomologists. Even now Brauer places them above the Lepidoptera and Diptera, but this seems to us to be erroneous, the beetles in their adult structure, especially the Staphylinidæ and Carabidæ being not so far removed from the Campodea-form type as the other metamorphic orders. With Brauer we regard the Staphylinidæ as being the most primitive group of beetles, and near them are the carnivorous groups (Cicindelidæ, Carabidæ, Dytiscidæ, and other Adephaga). Indeed, instead of considering the Rhyncophora as the "lowest," and therefore most primitive group, we are now strongly disposed to regard that group as neither "highest" or "lowest," but as the most highly modified of all beetles, and therefore as a whole probably more recently developed than the bulk of other Coleoptera. We would in classifying the Coleoptera begin with forms like the Carabidæ and Staphylinidæ, because their larvæ are the most primitive of coleopterous larvæ, *i. e.*, most campodea-shaped; and the imagines are more like their larvæ than any other beetles, differing mainly in having wings. Hence the Staphylinidæ and Adephaga are much nearer the ametamorphic Dermaptera and Orthoptera than the Rhyncophora, or beetles like the Lamellicorns, Cerambycidæ, Buprestidæ and other wood-boring Coleoptera, whose larvæ are either footless or tending to become so. Considering the larvæ alone is is evident that the carnivorous and leaf-eating forms, with flattened bodies, and well-developed legs, living a free, active life, neither boring into wood or other vegetable substances, but living under stones, or in the water, or on the surface of leaves—it is evident that these are the earliest forms, and that the larvæ of the Rhyncophora with their cylindrical, apodous bodies are much later, adaptive forms, which have lost their legs by disuse. The links connecting them with the earlier beetles are the Bruchidæ, for example, which in their first larval stages have long, well-developed legs, but which afterwards drop them, in adaptation to their weevil-like life in peas, beans, etc, The terms "high" and "low" are somewhat misleading, and for them should be substituted the expression more or less modified, or differentiated, recognizing the fact that the "lowest" forms are usually the more generalized and least differentiated, and especially least modified. When forms are rendered "low" by parasitism, they may be said to be degraded, retrograde or degenerate.

Now the same views will, we would suggest, apply in dealing with the Diptera. Compared with the Hymenoptera they are certainly more highly modified, but in a more or less special direction. The Hymenoptera are, it is now generally admitted, the most complicated or specialized and most differentiated group of insects; while, on the other hand, the Diptera appear to be a side branch of the insect tree, and both degenerate in important characters, and very much modified in others.

In the Hymenoptera there is a wonderful differentiation of the mouth-parts. Instead of the abolition of mandibles (Simulium excepted) and a reduction and modification of the maxillæ, which we witness in the Diptera, the three pairs of mouth-parts are not only very equably developed, but the parts are further elaborated with different portions specially adapted for special functions. In the Diptera the jaws are wanting, the maxillæ usually much reduced, while the labium is enormously developed and highly modified. The trunk of Hymenoptera is divided into three equally developed regions, while in Diptera the mesothoracic segment is enormously developed, the prothorax being aborted. In the Hymenoptera the wings of both pairs are well developed, in the Diptera the hinder pair have lost their function, as wings, and are greatly reduced and modified with the minute balancers, and more useful, perhaps, as organs of sense than of motion.

If we take into account, also, the differentiation of the brain of Hymenoptera, their social life, nest-building habits, the differentiation of the sexes, their high intelligence and very complete metamorphosis, the Hymenoptera certainly overtop the flies.

The larvæ of Hymenoptera are, except those of the saw-flies, very much modified, but the simplest more modified ones, those of ants, wasps and bees, are less modified than the maggots of the Muscidæ and allied groups.

And here we should, as in the case of the Coleoptera, reverse the usual arrangement of the Diptera. It is evident that a form like Simulium, in which the jaws are retained (though microscopic and in a rudimentary or reduced condition), is nearer what must have been the original, primitive Diptera than any other forms, usually in our systems placed above this genus. For a stronger reason the mosquito, especially the female, with its equably developed mouth-parts, the mandibles and maxillæ being well developed, is nearest to what was probably the earliest, most primitive, most equably differentiated Diptera. In classifying the Diptera, therefore, we should prefer to begin with the Culicidæ as being the most primitive unmodified Diptera, and end with the

house-flies and their allies, together with the sheeptick (Pupipara) as being the most highly modified, and the last to appear, of the dipterous series.

In the Hymenoptera there is nothing of this kind, we do not have entire groups of this order which have become so reduced, degenerate and modified, largely the result of parasitic life, as in the flies. The Hymenoptera are a normal blossoming or branching out of the topmost portion of the tree of insect life, while we should regard the Diptera as a degenerate, retrograde, downfallen branch.

If we look at the larvæ of Diptera we shall see that the most perfectly developed or highly differentiated forms are those of mosquitoes, black flies and the Tipulidæ, etc., (Encephala); then we pass on to a series in which the body becomes more and more maggot-like, the head being so reduced in the Muscidæ (in the old sense) that it is difficult to make out the homologies of the antennæ and parts of the mouth. The internal organs, as the tracheæ, share in this alteration and extreme modification of parts, adapting the maggot for its parasitic or otherwise peculiar mode of life and surroundings. Indeed, below the families embraced in the Orthorapha (Culicidæ, Simulidæ, etc.), the great group of Diptera now consists of very degenerate, highly modified forms.

Now under what canons of taxonomy are we to act in considering what forms are "high" and what are "low," unless we take into account the facts we have considered? It seems to us that the few entomologists and other naturalists who advocate placing the Diptera at the head of the insect series, disregard the fact that the processes of degeneration, reduction, with specialization in limited directions, and of adaptation to unusual modes of life, their habits being, in many groups, parasitic, or partially so, have brought about a modification of larval and adult structure, such as we do not find in any of the other larger orders of insects.

It seems to savor somewhat of a violation of the principles of classification, which in these days is based not only on comparative anatomy, but on morphology, paleontological history, and the facts of adaptation to changed conditions of existence, to give the highest rank to a group in which disuse of certain parts leading to degeneration, and the modification of other parts adapting them for quite peculiar uses, are so marked. And it is this wonderful amount and variety of modification and adaptation to this or that mode of life which makes the group one of such striking interest to the philosophic student. We see how much at the mercy of the environment the group has been exposed, and this is especially striking when we compare the Diptera with the great group of Lepidoptera, where there is a striking persistence and fixity of structural features, both in larva and imago, as well as in the modes of life, and the nature of the food.

BOOK-REVIEWS.

British Locomotives, their History, Construction and Modern Development. By C. J. Cooke. Whittaker & Co., London and New York, 1893. 376 p. 12mo. $2.00.

An interesting and very instructive account of the rise and progress of the locomotive, especially in Great Britain, including important details of construction and dimensions, as well as performance. It is written in a sufficiently popular style to be readable by any one having an interest in its subject, and is yet sufficiently technical to satisfy the specialist desiring information in relation to the proportions and the work, or even the general plans, of locomotives, old and new, including, of course, the now familiar "compound engine." The book is addressed, and most suitably, to all who take an intelligent interest in the working of the locomotive and of railways, and to practical railway mechanics as well. It is written by an employe of the London and Northwestern Railway, and is therefore reliable and accurate; its illustrations are from working drawings, and are supplied by the great locomotive designers of the United Kingdom, and are, therefore, valuable to the professional, as well as useful to the casual, reader. The early history of the engine, of the struggles in which George Stephenson and his contemporaries engaged to make steam a successful railway motor, and the later account of the modern compound engine are likely to prove most interesting to the average reader; but no one should omit the careful perusal of the last chapter, on the duties of the locomotive engine-driver, in which he will find much to impress him with the wonderful combination of courage, skill, intelligence, foresight, knowledge and readiness, in times of emergency, which is demanded of that humble and rarely appreciated craftsman.

Negative Beneficence and Positive Beneficence: Being Parts V and VI of the Principles of Ethics. By Herbert Spencer. New York, D. Appleton & Co. 12mo. $1.25.

This volume completes Mr. Spencer's ethical treatise, so that all who wish to know the final views of the philosopher of evolution on questions of conduct and duty are now enabled to do so. In the opening chapter Mr. Spencer draws a very sharp distinction between beneficence and justice, as he understands these terms, and then proceeds to show that beneficence has two forms, the positive and the negative. He then discusses various forms of negative beneficence, which consist in refraining from acts that would be injurious to others or to society at large, and afterwards those forms of positive beneficence which he deems most important. He confines himself almost entirely to private and industrial life, and we look in vain in these pages for any recognition of that beneficence that shows itself in advancing human knowledge and human virtue. Indeed, with the exception of certain passages in which the author's excessive individualism shows itself, the book is of a commonplace character; and whoever takes it up with the expectation of having his moral ideas clarified or his moral sentiments quickened and elevated, will be disappointed.

But what is more remarkable is that Mr. Spencer, as we learn from his preface, is himself disappointed; for, after congratulating himself on the completion of the work, he says:

"My satisfaction is somewhat dashed by the thought that these new parts fall short of expectation. The doctrine of evolution has not furnished guidance to the extent I had hoped. Most of the conclusions drawn empirically, are such as right feelings, enlightened by cultivated intelligence, have already sufficed to establish. Beyond certain general sanctions indirectly referred to in the verification, there are only here and there, and more especially in the closing chapters, conclusions evolutionary in origin that are additional to, or different from, those which are current." For our part, we can see no connection between the law of evolution as propounded by Mr. Spencer and the moral law; and we cannot perceive that he has shown the existence of such a connection. Both in this volume and in the preceding one on "Justice" evolutionary principles are brought in only occasionally and incidentally; and, when they are brought in, they are generally irrelevant to the discussion. Indeed, how can the study of a merely natural process like evolution teach us what we ought to do? How can we even know whether evolution itself makes for good or for ill unless we already have a moral ideal by which to judge its results? We fear that those who have been expecting evolutionism to furnish a guide of life will have to look in some other direction.

The Religion of Science. By Dr. Paul Carus. Chicago, The Open Court Pub. Co. 12mo. paper.

In this work Dr. Carus has undertaken to expound what he believes is to be the religion of the future. He disbelieves, as our readers doubtless know, in anything supernatural, but holds fast to the ethical teachings of Christianity and to the Christian ideal of character. It is true that he uses the Divine name frequently; but he expressly teaches that God is not a person, but merely the eternal and all-controlling power in nature. Sometimes he uses the language of pantheism; yet he insists that his doctrine is not pantheism but, as he terms it, entheism. He denies the existence of the soul as a distinct entity, and of course disbelieves in its immortality. Everything in the old religions that savors of the supernatural he regards as mythology, and maintains that it is destined to pass away, leaving nothing but the moral teachings and aspirations bequeathed to us by the prophets of old. He holds his creed with unquestioning faith, and is rather intolerant of those who still cling to the ancient creeds. "What the Roman church claims to be," he says, "the religion of science is. The religion of science is the catholic and orthodox religion." He is rather bitter against the churches for their adherence to forms and ceremonies and to what he deems erroneous doctrines, and declares that their religion is radically different from that of Christ himself. With much that he says we fully agree, and we respect the moral earnestness with which he discusses the problems of life and duty; but we are not prepared to follow him in rejecting theism, and we have much less confidence than he seems to have in some of the doctrines and criticisms that are put forth in the name of science. Yet we have read his book with interest, and we cordially echo the sentiment he expresses that "blessed is he who trusts in the truth, who hearkens to its behests, and leads a life in which obedience to truth is exemplified."

The work here noticed is to be published with others in a series entitled "The Religion of Science Library," the volumes of which will be issued bi-monthly in paper covers at 25 cents each or $1.50 a year. The first number in the series, which bears the date of September, 1893, is a reissue of Max Müller's "Three Introductory Lectures on the Science of Thought," which was noticed in these columns when it first appeared some years ago; and other works new and old will follow in due season.

Heat. By Mark R. Wright. Longmans, Green & Co., N. Y., 1893, 336 p. 12 mo. $1.50.

This text-book of heat and thermodynamics is a well-planned and well-executed work, suitable for the classes of high schools and colleges in which an elementary course has been given, as introductory to this subject, in the usual first lessons in physics. It is made up with a view to use in connection with instruction in the laboratory, as well as in the lecture-room, and contains an excellent outline of the thermal and thermodynamic principles constituting the modern science of heat, illustrated by experiment, and enforced by numerical examples, not numerous but very carefully selected, and in every case apposite to the text. The book is, in physics, what Remsen's text-book is in chemistry, a well-prepared outline of the theory and experimental method of exposition of the science. The units employed are both the British and the metric, the C. G. S. systems. Students about to take up the applications of such principles in the advanced classes of colleges, and especially of the technical schools, will find this an excellent preparatory course. In the introduction to the chapters on thermodynamics, the work of Rumford and of Davy is given proper place, and more credit is given the former than is usual in earlier treatises. Regnault's work is quite fully discussed, and the algebraic treatment of the thermodynamics of gases and vapors is unusually satisfactory. The book is printed on heavy paper, in excellent type, is well illustrated, and well bound.

Outlines of Pedagogics. By Professor W. Rein. Translated by C. C. and Ida J. Van Liew. London, Swan Sonnenschein & Co.; Syracuse, N. Y., C. W. Bardeen. 12mo. $1.25.

This work, by the director of the pedagogical seminary at the University of Jena, is written from the standpoint of the Herbartian philosophy, and is designed to set forth Herbart's theory of education as developed and modified by his disciples. The work, like so many others that come to us from Germany, is not always easy to understand; and, though it contains much that is sound and suggestive, we doubt if it will effect any radical change either in the theory or in the practice of English and American educators. The whole book is written from a German point of view and with reference to German needs; and the division of the school system according to the German division of society into classes is assumed as something final. The parts of the book that are likely to be most interesting to American teachers are those in which the author discusses the end and aim of education and the subjects and method of instruction. The end at which all education ought to be directed is, in Professor Rein's opinion, the formation of character; and he lays such exclusive stress upon the training of the will that he almost forgets that the intellect and the feelings are entitled to consideration on their own account. Nor do we find that he offers anything essentially new as to the means of forming character; for, though he devotes considerable space to the subject, he suggests nothing to the purpose except the study of good literature and the employment of teachers of excellent character. With regard to instruction Professor Rein holds opinions somewhat different from any now prevalent in this country; and, while we cannot endorse all that he says on the subject, there is much in it that is suggestive. He holds, with Comte and others, that the education of the child ought to follow the steps that the race has taken in its historical development; but, notwithstanding the authorities that may be cited in support of this theory, we venture to think that an education based upon it would be ill adapted to the requirements of a civilized age. The importance of the right method in teaching is a subject on which the author lays great stress, and practical teachers can hardly fail to get from him some hints and warnings that will be useful. The book will serve a good purpose in drawing renewed attention to the importance of moral training, and also by presenting certain aspects of educational work that have not been generally discussed in America.

Birds of Michigan. By A. J. Cook. Bulletin No 94, Michigan Agricultural College. 148p. illus. 8vo.

This Bulletin marks something of a departure in the work of experiment stations. Most of the bulletins issued under the auspices of these wards of the Government are devoted to purely agricultural topics such as feeding of pigs or cows, dairying, planting potatoes, cultivation of corn, value of fertilizers, spraying for fungous or insect diseases and kindred subjects. Some few of the stations publish work of a high character, work which shows some originality. It must be confessed, however, that too much of the station work is of a very poor quality. Often it is a rehash of some previously issued experiments, in which the errors are copied along with the correct statments. Often it consists of descriptions of hastily made experiments which lead to no practical results; or else it may be an account of some experiment which had been tried with negative results years before, but of which the

author of the "new" experiment was totally ignorant. The present publication does not lay claim to any profound scientific knowledge or pretend to herald any new discoveries. It is a catalogue of the species of birds known to occur in Michigan, compiled from various published and unpublished data, with notes on localities and other items. There are 332 species recorded. Abstracts are given of bird and game laws, and a bibliography of over 200 references adds to the value of the whole. The illustrations, mostly taken from Coues's "Key to North American Birds," will prove of great assistance to those using the Bulletin in the state. J. F. J.

LIQUID AND SOLID AIR.

BY JOHN S. MCKAY, PACKER INSTITUTE, BROOKLYN, N. Y.

The physical state, or condition, of a body is entirely incidental and never dependent upon any inherent property. The same substance may be solid in one zone and liquid or gaseous in another. According to the kinetic theory, the different states of matter are only different modes of molecular motion and any change of state is the result of the absorption or liberation of energy. By the addition of sufficient heat energy all solids and liquids become gases, and by withdrawing such energy all gases may be reduced to the liquid or solid state. It is probable that at the temperature of absolute zero (–273°C.) there would be neither solid nor fluid, but that if matter still continued to manifest itself to our senses, it would be in a different physical form from anything now known. It is certain that there could be no gases at that temperature, since molecular motion is essential to the idea of gaseity. From recent experiments it seems probable that all gases, under ordinary atmospheric pressure, would become liquid or solid before reaching absolute zero. It is a well-known fact that after a gas has been cooled below its critical temperature it may be reduced to the liquid state by the aid of external pressure. Until a few years ago oxygen, hydrogen, nitrogen, air, and a few other gases had never been reduced to their critical temperatures and hence could not be liquefied. Air had been compressed until it was denser than water without any trace of liquefaction. And so these gases were called permanent or incoercible gases. But in 1879 Cailletet of Paris and Pictet of Geneva, working independently and by somewhat different methods, succeeded in reaching the critical temperature of some of these gases and by great pressure reduced them to the liquid form. Since then all known gases have been liquefied and the old distinction of permanent and coercible gases has been effaced.

The critical temperature, or absolute boiling point, of these gases is very low, being –140°C. for oxygen, –146° C. for nitrogen, and –240° C. for hydrogen. This low temperature is obtained by evaporating in vacuo liquid NO, CO_2, SO_2, or some other substance whose critical temperature is comparatively high and which is therefore easily liquefied. As yet hydrogen has been liquefied only in small quantities by allowing it to expand suddenly when at a low temperature and highly compressed. In some remarkable experiments before the Royal Society of London during the past year Prof. Dewar made use of liquid ethylene to secure the low temperature necessary to liquefy air and oxygen. By means of three concentric vessels, the outer one containing liquid nitrous oxide and the next one liquid ethylene, both being connected with powerful vacuum pumps to increase the evaporation, he secured so low a temperature in the inner vessel that oxygen, nitrogen and air were liquefied in large quantities with comparatively little pressure. By causing a vacuum to act upon a large tube containing liquid oxygen, a temperature of –210° C. was produced. A small empty test-tube inserted into the boiling oxygen was so cold that the air of the room at ordinary pressure condensed and trickled down its sides. By evaporating liquid nitrogen in a vacuum, a temperature of –225° C. was reached, at which point nitrogen became solid.

Liquid oxygen when first formed is milky in appearance, owing to the presence of some impurity which may be removed by passing it through ordinary filter paper. When pure it is of a pale blue color, which, however, is not due, as some have thought, to the presence of liquid ozone, which is of a dark blue color. Liquid oxygen is a non-conductor of electricity but is strongly magnetic. It may be lifted from a cup by presenting the poles of a strong electro-magnet. It seems to have very slight chemical activity, since it will extinguish a lighted match and has no action on a piece of phosphorus dropped into it. It is well known that the A and B lines of the solar spectrum are due to oxygen, and, from recent experiments on the top of Mount Blanc, it is thought that they are largely if not wholly due to the oxygen in the earth's atmosphere. Prof. Dewar showed that these lines come out very strong when liquid oxygen is interposed in the path of the rays from an electric lamp.

Liquid air is at first somewhat opalescent, owing probably to solid particles of carbon dioxide. It may be cleared by filtering or by standing for a few minutes, when the particles rise and disappear. When any of these liquefied gases are placed in an ordinary glass vessel they boil vigorously and soon disappear owing to the heat obtained from the vessel and surrounding objects. In a vessel made of rock salt they take the spheroidal form and last much longer, but Prof. Dewar found that they could be kept longest in vessels with double walls with high vacua between them. A small bulb filled with liquid air and protected by a vacuum would require an hour and a half to boil away, five times as long as it could be kept in an ordinary vessel. Liquid air has the same high insulating power as oxygen but is less magnetic. Its magnetic power is evidently due to the oxygen, since liquid nitrogen is not magnetic. When the oxygen is attracted by a magnet it draws the inert nitrogen along with it without being separated, but if a sponge or ball of cotton be saturated with liquid oxygen and presented to a magnet the liquid will be drawn out of the meshes and cling to the magnet until it evaporates. The normal boiling point of nitrogen is about eight degrees below that of oxygen, so that the two substances may be separated by distillation, the nitrogen boiling off first and leaving the oxygen. But when air is being liquefied the nitrogen does not come down first, as might be expected, but the two condense together at a temperature about midway between their respective boiling points.

All the liquefied gases except oxygen and hydrogen have been frozen by self-evaporation in a vacuum. By evaporating liquid air in a vessel surrounded by liquid oxygen, Prof. Dewar succeeded in reducing the air to a clear, transparent solid. It has not yet been determined whether the oxygen of the mixture is really frozen or merely entangled among the particles of solid nitrogen in some such way as rose water in cold cream, or water in the solid gelatin of calves' foot jelly. Although pure oxygen has never been frozen it is possible that when mixed with nitrogen its freezing point is raised so that the two solidify together.

One of the interesting things connected with these recent experiments in the liquefaction of gases is the fact that it enables us to produce a lower temperature than ever before. We are slowly creeping down toward the absolute zero and the possible solution of the mysteries connected with the nature and constitution of matter. Is

it not possible that we may yet be able to separate matter from energy and thus form some conception of matter pure and simple? When the molecules cease to vibrate what would be the state or condition of matter? Would it still manifest itself to the senses? If so, what properties would it retain, what new ones acquire?

FUNGI PARASITIC INDICATE KINSHIP.

BY BYRON D. HALSTED, RUTGERS COLLEGE, NEW BRUNSWICK N. J.

It is difficult in a short title to express the leading thought of this paper. Possibly it may be expressed as follows: Fungi, when strictly parasitic, as a rule, infest either a single species, or, if more than one, the hosts are not distantly related. It is therefore to these species that have a wider range than a single sort of host that attention is called at this time. Please bear in mind that the word "strictly" is employed in the statement of the proposition. Therefore it may be possible to draw something of a conclusion from instances when a fungus grows with almost equal ease upon a wide range of substances. But this is a matter of secondary importance at the present time. For our purpose a fungus may be considered strictly parasitic when it attacks what appears to be perfectly healthy tissue, as the leaf or stem of a plant in the full flush of its vitality. Let some instances be cited to make the fact emphatic. Three years ago there was an outbreak of trouble in a Jersey cranberry bog. The leaves, blossoms and young stems became distorted with numerous minute galls, due to a microscopic fungus (*Synchytrium Vaccinii*, Th.). The cranberry being a bog plant is under water for a part of the year and the shore plants bordering the bog are likewise submerged for some time as well. The fungus discharges its spores into the water, and they are carried to all parts of the bog and the overflowed neighboring land during the spring floods. During the investigation of the cranberry gall trouble the shore plants came under notice, and it was found that several kinds of them were attacked in a way similar to the cranberry. Two interesting facts were obtained in the investigation; first, that the cranberry gall fungus attacked the shore plants up to a certain well-defined line. If the shrub was low it would bear galls throughout, but a high one had them only upon the lower leaves and branches. In short the gall fungus attacked those parts only that were under water at the time of the floods when the spores were being disseminated in the water. The second interesting fact was that all of the shore plants showing signs of infection were all members of the same family (*encaciae*) with the cranberry. The hosts among themselves are widely different in general appearance, and it was remarkable how dissimilar were the galls upon these various species. Upon the white alder, for example, the galls were large and hairy; while upon the wintergreen and sheep laurel they were smooth. But without going into the details of minute structure there seems no doubt that all forms are of the same species, and while the water must have been well charged with the germs and bathed for days or weeks the entire vegetation of the submerged shore, none but the members of the heath family were affected.

The demonstration is quite complete that the presence of this fungus indicates kinship among the host plants. So strong is this that should a new host be found for this gall fungus the first thought would be that the victim is a member of the heath family of plants.

Similar instances might be mentioned in connection with other fungi, and that almost without number. In the case of fungi attacking fruit the circumstances are somewhat different and this sends us back to the word "strictly" in the original proposition. It may be contended with considerable show of reason that a fruit, particularly if it is nearing maturity, is not altogether alive, but instead, having become the receptacle of various substances to facilitate the dissemination of the maturing seeds within, is passing from the condition of a highly vitalized portion of the plant to a passive condition that will soon be on the verge of decay. This being the case, it is not exceptional to the rule when it is found that a mould that grows upon the tomato may thrive equally well upon the peach or plum. The soft tissue in each case is similar and the fungus does not need to overcome the resisting force, peculiar to each species, that is associated with the living portions of the plant. Should the fungus in question grow also upon the other-

wise healthy foliage, of the tomato, peach and plum, the question would be different. It would be a true parasite that was able and willing to flourish upon the fresh products of life, namely, the fruit. The leaf fungi, as a matter of fact, are widely different from those of the peach and plum, and those of the cherry and plum, for example, are often identical; and the hosts are within the same small group.

Passing to a small group of closely related plants; namely, the cucurbits, it is interesting to note how wide spread some of the fungi are preying upon the species. Thus the water melon is frequently badly affected with an anthracnose, which growing in the rind of the maturing fruit causes it to become full of decayed pits. The muskmelon suffers from the same fungus but the texture of the skin of its fruit is so different that the decay might be considered as not the same as the one of the watermelon. A third member of the same family, namely the cucumber, is not exempt from the same enemy, as the accompanying engraving will indicate. This illustration is from a photograph of one of a bushel or more of equally bad specimens met with at a market place. The cucumber being of a softer texture is much more quickly destroyed than the muskmelon or watermelon.

This anthracnose (*Colletstrichum lagenarum* (Pass) E and H.) thrives upon the foliage of the three named hosts causing a leaf blight. It is a true parasite and assists in indicating the close kinship of the hosts.

—"Our Own Birds," by Wm. L. Bailey, published by J. B. Lippincott Company, is an excellent manual for those who wish to become familiar with the common birds of this country. It contains a number of half-tone full-page illustrations, with others in the text.

CURRENT NOTES ON ANTHROPOLOGY.—XXXIII.

(*Edited by D. G. Brinton, M. D., LL.D., D. Sc.*)

OLD SKULLS, AND PERHAPS THAT OF SOPHOKLES.

LAST year, before the British Association, some skulls were exhibited and described, which were of men said to have lived six thousand years ago. They were brought by Mr. Flinders Petrie from Egypt and taken from tombs of the third or fourth dynasty. They were rather dolichocephalic,—about 75,—and from the general relations of the skeleton, belonged to a somewhat undersized race, with negroid characteristics. They may have been slaves, or a mixed strain.

Not less interesting is the description recently given by Professor Virchow, in the Proceedings of the Royal Prussian Academy of Berlin, of some Greek skulls of ancient date. One of them, from Menidi, was believed by its finder to be that of the great classical dramatist, Sophokles. The oldest were from Mykenæ, Spata and Nauplia and were prehistoric. They were all slightly brachycephalic, orthognathic, with the nose rather broad.

The grave of Sophokles is believed, on a certain amount of literary evidence, to have been on the road from Acharnai, the modern Menidi, to Dekeleia, about 11 stadia from the latter. Following this clue, the archæologist Münter opened a tumulus at this point, and came upon a a stone wall enclosing four sarcophagi, two of marble, each containing a male skeleton. One of these was of a very old man, with a cane by his side, an alabaster vase, etc.

Sophokles died at ninety years of age in B. C. 406, so the character of skull, as that of a very old man, corresponds. It proves on examination to be long, 73.3, with a remarkable irregularity between the right and left hemispheres, the left temporal suture nearly obliterated, the forehead broad, the face narrow and high and slightly prognathic, the nose narrow, the capacity low, 1340 c. c. Possibly it is the very skull of the old poet.

THE AFRICAN PIGMIES.

FEW anthropological questions are of so much importance as that of the African pigmies. In the last number of the *Zeitschrift fur Ethnologie*, Mr. Stuhlmann, who had been with Emin Bey, gives some interesting facts about them. Their height is about 1.25 metres, the head round, the nose flat, the face very prognathic, the hair spiral-woolly and brown, the skin light-brown with an undertone of reddish-yellow. The beard is scant, a light, down-like hair covers the whole body, and the effluvium of the person is penetrating and disagreeable. They differ very much, therefore, from the true negro race.

Mentally, they are cunning, cruel, with keen senses and thieving propensities. They use small bows with poisoned arrows, live in slight temporary shelters, and wear light clothing of leaves or strings. Their language has no numerals, and is related to that of the Wambuba tribes. They appear to have no ornaments, nor to tattoo the skin, but they occasionally bore two holes in the upper lip. They seem to have some religious notions, as they are careful to bury the dead in a particular position. They have some form of marriage, and cannibalism is not general.

Stuhlman does not believe that these dwarfs came about through degeneration, but that they are the relics of a peculiar variety of the human species which once extended over Africa and probably reached into Asia. They have many childish traits, their skeltons are in various respects undeveloped, and they may be regarded as a race of human beings which has undergone permanent arrest of evolution.

This was also the conclusion to which H. Panckow arrives, in an article published in the Journal of the Berlin Gesellschaft für Erdkunde, in 1892. He claims that an original diversity is proved by such traits as the color of the skin, the development of the gluteal muscles, the smallness of the hands and feet, etc.

It must be said, however, that these peculiarities are only somewhat greater in degree than those of the Bushmen, the Lapps and other diminutive races; and it is not yet necessary to demand for the African dwarfs an origin different from that of the rest of the human race.

FURTHER ON THE "HITTITE" QUESTION.

IN *Science*, May 26, I referred to some recent studies about the so-called "Hittites," or rather, once so-called, but so no longer. The Hittites, as real people, are now determined to have been a Semitic tribe, speaking a dialect not remote from that of Phenicia. They are not the people who wrote the mysterious inscriptions in syllabic characters which still so puzzle the antiquary. These are now referred to as "Pseudo-Hittites," or as before said, Chaldi.

Their language is still unclassified. M. Menant claimed to have fixed two of its words, *kar*, a fortress; and *sarou*, king; but these are Semitic, so he was off the track. Professor Sayce, in the edition of his "Comparative Philology," published last year, asserts that it "belongs to the Alarodian group of speech, of which the Georgian may be taken as an example;" but Professor Sayce's identifications and translations (?) of the Vannic inscriptions have been treated with small respect by the latest students.

Among such students may be named Lehman, Belck and Nikolsky. The last-mentioned has printed twenty-two Chaldic inscriptions with attempted renderings, in the Proceedings of the Moscow Archæological Society. It is claimed that these determine positively several words, such as *ainei*, stone; *inili*, palace; *tiini*, named; and a few more. One of the most important inscriptions is that of the styla of Rusas at Toprakaleh, which promises to yield its contents to persistent study.

The present tendency seems to be to regard the Chaldi as of Indo-Germanic origin, probably immigrants from Europe, and their culture largely self-developed. Lehmann, in the last number of the *Zeitschrift fur Ethnologie*, gives the credit of first broaching this theory to Professor Puchstein.

ANTHROPOLOGY IN ROME.

IT IS a gratifying evidence of the scientific activity which prevails in Italy, that in June last the Societa Romana di Antropologia was founded at Rome, with a membership of about one hundred founders. The aim of the Society is broad, anthropology being understood in its true sense as the science of man in all departments of his nature. The announcement therefore states that the publications of the Society will embrace papers of the physical traits of man; his origin and pre-history; his ancient migrations; arts and social relations; the ethnic influence of peoples on each other; collective and ethnic psychology and pathology; and the physical and mental education of tribes and nations. The Society is not confined to citizens of Rome, but intends to include those interested in these studies throughout Italy.

The President is Professor Giuseppe Sergi, the distinguished teacher of anthropology in the University of Rome; and among the members are Dr. Angelo Colini, docent in ethnology in the same University; Dr. L. Moschen, docent in anthropology; Dr. E. Raseri, docent in statistical demography, in the same; Dr. E. Brizio, professor of archæology in the University of Bologna; Dr. V. Grossi, docent in American ethnology in the University of Genoa; Dr. A. Zuccarelli, professor of criminal anthro-

pology in the University of Naples; Dr. Riccardi, docent of anthropology in the University of Modena; and many others whose works have secured them well-earned titles of honor.

Professor Sergi himself is one of the most industrious of anthropologists. Within the present year I have seen from his pen a learned essay on the "Principles and Methods of Classifying the Human Race," by craniological forms; a "Systematic Catalogue of the Varieties of Man found in Russia;" and a Report on the Anthropological Congress in Moscow in 1892. No doubt under his active guidance the new society will have a prosperous career.

NOTES OF SOME EXPERIMENTS ON THE HOUSE-FLY.*

BY JOHN B. SMITH, SC. D., RUTGERS COLLEGE, NEW BRUNSWICK, N. J.

INSECTS, in some circumstances, exhibit a tenacity of life which is extremely surprising. They will stand a great deal of mutilation, apparently without manifesting pain, and will get along quite comfortably on a minimum allowance of wings and legs

The house-fly is about as common an insect as we have, and I was led recently to try some experiments with a view to locate, as nearly as might be, the seat of life—or rather the controlling nerve centre, for life exists in each cell—in this insect. A number of flies were captured and decapitated. This process, of course, severed not only the nervous cord, and separated the brain from the rest of the body, but it cut as well the alimentary canal, and the main blood vessel, the Aorta. Flies so treated lived from ten to sixteen hours. They had, of course, lost all sense of direction; but had not lost the use of any of their limbs. When they were touched with the point of a needle they would walk away; but always in a straight line, and without attempting to avoid any obstacle that might have been in the way; if the annoyance was more than a little, they would attempt to fly. As in the former case, they were unable to direct themselves, and as soon as they met with an obstacle would rest quietly until again irritated. So long as they were left undisturbed they remained at rest, or if a pencil was presented to them between the fore legs, they would crawl up for a short distance, and again rest quietly. In such cases it was rather difficult to make them loosen their hold; they would cling tightly, and would not, if they could avoid it, loosen their grasp until something else was presented to them to which they could attach themselves. There seemed to be a realization that something was wrong, and occasionally the front legs would pass over the place where the head ought to be; but there was not at any time what could be considered as a manifestation of pain.

From another set of flies the abdomen was cut. This severed the nervous cord, the heart and the digestive system including in the latter almost all save the œsophagus. These insects lived for from six to ten hours, and for a large portion of the time they were active, flying about and running, and in fact behaving themselves like insects that were in all respects normal. As in the other case there seemed to be no active manifestation of pain. For a short time, say half a hour after the abdomen was severed, the insects were constantly extending and withdrawing the proboscis, evidently realizing that something was wrong, in that connection. At no time was there any interference with the power of motion, either of the legs or wings, and in fact it was impossible to see any difference between their case and those of perfectly normal flies, under the same circumstances and confined with them.

*Read before Section F., at the Madison meeting of the A. A. A. S.

Perhaps a few words of explanation concerning the gross anatomy of the fly may not be entirely out of place in order that my experiments may be better understood. Insects, generally, have only a single blood vessel, extending the full length of the body, and lying just beneath the dorsum, or upper surface. The digestive system occupies a large portion of the abdomen, and the central part of the thorax. The nervous system extends the full length of the body, in the form of a double cord, on which there are at somewhat irregular intervals enlargements or ganglia, and it lies on the floor of the body, just above the under surface. That ganglion which is situated in the head, is called the brain. We have seen that severing the brain from the rest of the body did not kill the insect; the severed head in no case showed any power of motion in any of its parts, no matter what means were taken to excite it. So long as the head was left attached to the body, even if the abdomen had been cut off, all the mouth parts, and the antennæ could be readily excited and made to move. No insect that had been mutilated by cutting off the abdomen could be induced to feed or attempt feeding. Cutting off all that part of the nervous cord that was situated in the abdomen produced no interference with the powers of motion. From another set of specimens both head and abdomen were removed, leaving only the thorax with its appendages; how much life remained in the abdomen it was impossible to say, since it contained no appendages that could be readily stimulated. The head, as already mentioned, soon died; but the thorax alone retained life for more than six hours, and these fragments of insects could be readily made to walk, although rarely could they be induced to make use of the wings. Yet if one were held up by the legs with forceps, the wings would be used in trying to escape, and would buzz as lively as if the insect was in full possession of all faculties.

From a number of other specimens the abdomen and that portion of the thorax containing the hind legs were removed. These specimens lived for from five to six hours. Both fore and middle legs remained perfectly active, and the mouth parts were readily stimulated. The hind legs could not be stimulated even where that portion of the thorax bearing them remained attached to the abdomen.

Another set of specimens was treated as were those last mentioned, except that the head also was removed. Here two-thirds of the thorax, containing two pairs of legs, remained alive quite as long as when the head was attached to it; the presence or absence of the brain appearing to make no difference. Other specimens were taken and these were cut in two between the first and second pairs of legs. The anterior p rt, containing the head and fore legs, remained alive for from four to five hours, although of course incapable of moving about. It was easy to induce an insect so treated to extend its tongue, and indeed this was done quite frequently by the insect even without stimulation. The legs were passed at intervals over the front of the head and there was no difficulty in exciting them to motion by merely touching with a needle or any similar instrument. That part of the insect containing the middle and hind legs and the abdomen seemed devoid of active life, and it was impossible to induce these structures, or the wings, to move, within a very few moments after the operation. Another set of specimens was treated exactly as those last mentioned save that here the head also was cut off. In this case the fragment of the thorax containing the front legs lived for three hours, while the other portions of the insect were apparently dead a very few minutes after the operation. An insect cut in half through the prothorax died almost immediately, neither portion responding to such stimuli as I employed, more than a very few moments after.

To test this matter in another way, I captured a number of specimens and with finely pointed scissors cut the heart or dorsal vessel, at the middle of the thorax. These insects lived nearly twenty-four hours, proving that the circulation of blood is not dependent entirely upon the heart, and, in fact, these insects lived as long as others which were not mutilated at all, and were kept in the same dish merely as a check. I could not find that these insects differed in their actions in any way from those that were perfectly normal. Another set of specimens was treated by cutting not only through the heart, but also through the œsophagus where it passed through the prothorax, and thus the alimentary canal was severed. Specimens so treated died somewhat sooner than did the previous lot, although they also lived nearly twelve hours. It was also noticed of these insects that the tongue or proboscis was frequently extended and retracted as in the case of those insects in which the abdomen was removed. Another set of specimens was treated by cutting the nervous cord in the thorax just behind the posterior legs. This resulted in the paralysis of the hind legs, but did not appear to affect either the fore and middle legs or the wings. Where the cord was cut between the middle and hind legs, exactly the same result was obtained. Cutting the cord between the fore and middle legs, close to the middle legs, however, resulted in the paralysis of everything behind the fore legs, and of the wings as well; although the insect lived for more than six hours afterward, both the head and its appendages and the fore legs responding readily to stimulation. As a result of this crude series of experiments, it would seem that the vital point, or, better, the controlling nerve centre in flies, is located in that large ganglion situated in the prothorax, just above the fore legs, and that so long as this remains intact, the insect retains power of motion and evidences active life. Severing or piercing this ganglion, killed the insect at once.

LETTERS TO THE EDITOR.

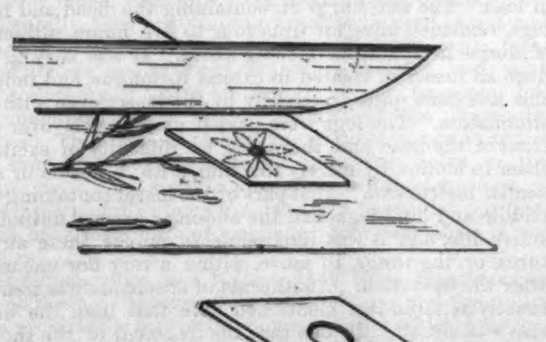
*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

HERBARIUM SPECIMENS.

IN preparing specimens of the Composite family for the herbarium, it is difficult to press the flower so that the



rays will not wilter, owing to the fact that the head keeps the paper from pressing upon the rays. The following device has been used by the writer with much success in preventing this difficulty, and might be useful to students who are collecting autumn flowers.

A small square or disk is cut from blotting paper and a hole is cut in its centre, a little larger than the head of the flower. If, in pressing, this disk be put over the flower, allowing the head to come up through the hole in the centre, the rays can be pressed out flat. The thickness of the disk should vary accordingly as the head is thick or thin.

RICHARD H. RICH.

Beverly, Mass., Sept. 25, 1893.

MINNESOTA MOUNDS.

I READ with considerable surprise Mr. Schneider's article entitled "Notes on Some Minnesota Mounds" in *Science* of Sept. 1, and I at once felt it to be my painful duty to correct some gross misrepresentations. I happened to be working in the same party with Mr. Schneider when he made the valuable discoveries which he describes and therefore am in a position to criticize his statements.

It is true that we found a number of Indian burial-grounds in the vicinity of Mille Lacs. Most of these were still in use, or had been so until quite recently. In two which I assisted in opening we found some decidedly modern relics, e. g., a U. S. ten cent piece used as a bangle, a glass butter-dish, a rubber comb and a jack-knife such as any Yankee boy might carry. These graves were arranged in rows and were usually covered with superstructures of wood, which might be compared to dog-kennels. We found a few graves rather older than the above, and which were covered with low mounds of earth, but even here there were traces of wooden stakes, which gave evidence of their recent origin. As to the mound at Lake Warren, which Mr. Schneider dug into, I confess that I was not present when it was opened. I have, however, seen the "relics" which were collected from it—in fact I am in a position to see them whenever I wish. Without stopping to question whether the age, sex and stature of the individuals could be accurately determined from the very fragmentary skeletons which he found. I would say that the bones are nearly as well preserved as some which we found in one of the covered graves above described and which I know to have not been buried more than twenty-five years. It is hardly necessary to point out the absurdity of supposing that a hole in which the "roughness of the sides" was still apparent could have been filled for several hundred years.

The specimens of pottery which he describes are merely fragments of baked clay utensils of the roughest sort, just such as all the American Indians manufactured before they obtained iron kettles from the whites.

In fact there is not the least evidence that any of these bones or relics are of any great age or that they belong to any race older than the Indians which inhabit this district at present. They are of no more value to the archæologist than bones dug from the nearest cemetery.

FRANCIS B. SUMNER.

University of Minnesota, Minneapolis, Minn., Sept. 23, 1893.

ORIGIN OF GOLD.

I WOULD like to draw attention to a somewhat fallacious deduction which appeared in an interesting little article, "The Origin of Gold," in your issue of Sept. 1st. The author mentions the remarkable fact that, in a part of Southern India, quartz-veins, though traversing both gneiss and belts of rocks, which have been termed the Dharwar, are gold-bearing in the Dharwar only, and are never productive in the gneiss. Mr. Lake then argues: "It is clear, therefore, that the gold cannot have been introduced into the reefs from below, for in that case there would be no difference in that respect between the reefs in the gneiss and the reefs in the Dharwar."

Without wishing to uphold the ascensional theory of the formation of lodes, it may be pointed out that the gold may have risen from below in both the veins in the gneiss and those in the Dharwar, but that owing to unfavorable conditions in connection with the gneiss (*e. g.*, absence of a precipitant) the gold has not been deposited in the veins in the gneiss. The case does not stand alone. The influence of the "country" on the productiveness of veins is a phenomenon well known and appreciated by mining engineers, and both the ascensional and the lateral secretion theories can be adapted to explain it.

It would have been interesting if Mr. Lake had given details of those observations which led him to believe that the schists of the district were lava-flows.

L. H. LINNELL COOKE.

Glasgow, Scotland, Sept. 22nd, 1893.

A PHONETIC ORTHOGRAPHY.

A NEW system of English orthography is proposed in *Science* (July 21), by Prof. J. I. D. Hinds, of Lebanon, Tenn., and endorsed with slight alterations (*Science*, August 25), by Frederick Krafft, of Jersey City Heights.

Reform, not revolution, in English orthography, is very desirable; but reform, to be successful, must be in accord with the spirit of the English language; it must also be attempted a little at a time. "Great reforms progress slowly."

Any system proposed that is simply phonetic must fail for the following reasons: (1) Our alphabet is inadequate; (2) the people of different sections or schools pronounce many words differently; (3) everyone would spell according to his own ideas of pronunciation, and there would be no standard. The fact that Prof. Hinds and Mr. Krafft, who attempt to agree, differ is evidence of that.

People are not all born with perfect audition and perfect powers of enunciation. These are matters largely of education. Perfection in these two particulars is very rare. In order that two persons pronounce all their words alike they must be of the same race or family and have the same teachers all their lives.

In America, where the most perfect English is said to be spoken, there are great differences in some of the vowel sounds in the different sections of the country. In any neighborhood in the west the same differences may be found according to the section from which the different neighbors came. The state or section from which a man came may usually be determined by his speech.

Without laying claim to perfection myself, but only to show the differences of pronunciation in different parts of the country, I wish to point out discrepancies in the pronunciation of these two gentlemen:

Professor Hinds offers *aa* to represent the sound of *a* in *father*, and then gives as an example, *waaz* for *was*. That will not do. The sound of *a* in *was* is very nearly the sound of *o* in *dog*. It would better be represented *woz*. Again he gives *waac* for *watch*. The vowel sound in that word is identical with the sound of *o* in *not*, and should be represented by *woc* (wotch). Mr. Krafft's representation *wac*, as if to rhyme with *thatch*, is worse yet, and is probably a typographical error. *Laaf* will do for *laugh*, if he likes it; but is it not rather pedantic and affected? Better the sound of *a* in *last*. Let the following nonsense sentence be read aloud and the differences of sound of the vowel *a* noted: "Father laughed hard after Fanny's hairless watch-dog was last granted fat."

Laj in *villaj* will not do. *Villaje* is much pleasanter. The sound of *a* in *village* is as *a* in *mate*, shortened, unaccented, and rendered somewhat obscure, less in time than short *e* in *edge* and less open in quality.

With in Prof. Hinds's extract may be an oversight. *Widh* would be better.

O'r should be *oer*, — long sound of *o*, not short.

Murmur will do; but *yondur, sobur and hurd* will hardly do. They have not the sound of *u* in *up*. *Dher* by Prof. Hinds, in the same line, may do for *their* if the word is not emphatic; otherwise his *dhair* (probably *dhaer* was intended) for *there*, and Dr. Krafft's *thare* for both *there* and *their* would be better. Yonder, sober and herd, ordinary spelling, would be less liable to be mispronounced, considering that *e* followed by *r* differs from *e* in *met*.

Puel, skuel and *lues* are very bad, when *ue* is given to represent *u* in *rule*. Undoubtedly Prof. Hinds meant that *ue* should represent *oo* in *tool*. *U* in *rule* is the same as *u* in *mule*, except that in *mule* a *y* is distinctly sounded before the *u*, and in *rule* the *y* is indistinctly sounded on account of the preceding *r*. *Pool, school* and *loose* are much different from *pule, skule* and *luce*.

U in *playful* should not be sounded as *u* in *up*. It should be as *u* in *pull*. For this sound Professor Hinds proposes *oo*. The notation then should be *plaefool*.

Weind should be *wind* (short sound of *i*). The word does not rhyme with *mind* and should not be so read. The rhymes are allowable, not perfect.

Some words in the extract are lengthened, defeating one of the objects sought, as *waaz, vackant, konfyuzhun*. Again, dissylables are written with a single vowel, as *sofnd, gabbld*.

Thus all this is designed to show the impracticability of a phonetic system. The one proposed is as good as any. No phonetic system will meet all requirements for the reasons here given: (1) Differences of pronunciation among different people, and (2) defective alphabet, necessitating the use of digraphs to represent some of the simple sounds.

Speaking of digraphs, how can we limit a simple sound to single digraph when our language now furnishes us with such a vast variety of digraphs, trigraphs, and even polygraphs to represent the different sounds? Take, for instance, the sound of *a* in *mate*. We are by no means limited to the twenty combinations presented by Professor Hinds. We must spell plague with *a-ue*. Naas with *aa*, Mælar with *æ*, and Græme with *æ-e*. Mr. Baehr is particular that we shall spell his name with *aeh*; while another Bhaer is equally strenuous that *hae* shall go into his name. Brahe, however, gives the letters another twist (ahe): while Mahlon drops the *e* entirely. *Praise* is stronger than *pain* in having a final *e*; and the Des Plaines River requires a final *es* to complete its orthography. Marais des Cygnes will have *ais*, Aisne *ais* and *e* final, while *chaise* (colloquially "shay") except the deacon's one-hoss one, carries the polygraph *aise*. We must remember to spell Basle with *as-e*, Naix and Morlaix with *aix*, Carhaix with *haix*, La Haye with *haye*, and Aux Cayes (O. K.) with *ayes*.

The Ray family is large and diverse. One branch clings to Rhe, showing *he;* another adds an *a* making it Rhea (*hea*); while a third, the Scotch Rea, omits the *h*. A gentleman of Ireland, who long ago built a castle (Castlereagh) near Lough Neagh (Nay), with his descendants, to this day spell the name Reagh with *eagh*; and a pioneer of the west, Mr. Reaugh (Ray), with probably a still more ancient lineage, delights in *eaugh*. The name of the late governor (Seay) of Oklahoma requires *eay* for its correct make-up; Payne wants *ay-e*, Cheyne *ey-e*, and a certain Swedish American, Hoeland, prefers *oe* in his name. When fully Americanized he will probably be Hayland.

Among words from the French, employé and resumé require an accented *e;* protegée one accented and one plain *e*, and the plural, pronounced similarly, an *s* additional, thus *ees*. Feting requires a plain *e*, crepe two, *e-e*, melee double *ee*, entrees *ees*, orgeat *eat*, entremets *ets*, mobilier *er*, and chef d'œuvre *ef* or *efs*, according to

whether the word is singular or plural. We will distinguish crochet with *et*, crocheted with *ete*, pique (the cloth) with *ue*, croquet with *uet*, and roqueted with *uete*. We must not forget that Duchesne requires *es-e*, Duquesne *ues-e*, Niquée *uee*, Torquay *uay*, and Queyrac *uey*. Chassez ("sashay") completes our French list with *ez*.

We spell seine with *ei-e*, eigne with *eig-e*, and eyot (ait) with *eyo*. We must remember rhaphe with *ha*, Thame in England with *ha-e*, heir with *hei*, and renaigue with *ai-ue*. As an oddity we find quegh, which ought to be obsolete, troubled with *egh* or *aich* (quaich), quoits ("quaits" in the country) has *oi*. Theys (tay) goes with *heys*, and old Mr. Trew (Tray) is ever faithful to *ew* in his name.

But why prolong this exhibit? The reader is already exhausted, and the chapter is not yet complete. Suffice it to say there are nearly one hundred different ways of representing the long sound of *a*, many of them in patronymics and names of places that need to be pronounced by English-speaking people. For other vowel sounds there is an equally extensive variety of representatives.

All this would, perforce, show the necessity of a reform in spelling—phonetic reform, if need be; but, on the other hand, the letters of a word are the earmarks, if you please, that indicate ownership—that show the philologic derivation and history of a word. Phonetic reform could never touch the majority of irregularities in spelling and retain any intelligence in the word. Therefore, with all its faults, our heterographic orthography is preferable to any homographic orthography that can be devised with our present alphabet.

What we can do is this: Drop some of our redundant letters as *me* from programme, *ue* from catalogue, etc.; final *e* from strychnine, etc., when the preceding vowel is short; *a* from plead (pled), past tense and pp., and similar words; change *ph* to *f*, as in sulfur. There is plenty of scope for good work in this direction, and such work will finally become permanent. We would become accustomed to these words, as to dock-tailed sheep, and prefer them.

B. B. Smyth.

Topeka, Kansas.

Feigned Death in Snakes.

For a long time I have desired information from others about a common trick of the ordinary "blowing viper," or "spreadhead snake" (*Heterodon*, in several species). I have observed that such animals when much worried, or slightly hurt, will frequently feign death. This habit has doubtless been often reported before, but I do not recall having seen definite mention of it in print but once. Several months ago, some one writing about snakes in a daily newspaper, alluded to this matter, and gave, as an explanation, the off-hand statement that the snake became frightened and "fainted from fear." That this is not the explanation will, I think, appear from what I have noted about several cases that came under my own observation.

The first time I ever noticed this behavior on the part of a snake was when I was a child. At that time I was one day crossing a field accompanied by an old negro man and a small dog. The dog found a common black "spread-head," and, without actually taking hold of it, began to worry it by running around it, snapping at it and barking. Anxious to save my friend, the dog, from what I supposed was deadly peril, I struck the snake with the only weapon quickly available, a small whip I carried in my hand. The snake immediately ejected a toad it had recently swallowed, then appeared to bite itself in the side, and promptly turned on its back and stiffened (but did not become stretched straight out) and lay perfectly still. There was not even a wiggle in its tail when pinched. Believing, as I then did, that all snakes were venomous, I supposed this one had killed himself; and remarking that he "seemed dead enough," I was on the point of leaving him. But the old negro said, "Oh no! If you leave them when they bite themselves, then their mates come along and lick the bite, and they come to." So I mashed the snake's head in a way that no amount of licking would ever heal. The old man evidently knew, by some means, that snakes which appeared thus to commit suicide would recover, and knowing no real explanation of why they should he invented one. Therein he followed the example of more eminent men than himself.

Before I again noticed such action by a snake I had

studied zoölogy a little and had learned that the spread-head was said to be non-venomous. Consequently when I next met one, and began to cultivate a closer acquaintance with him, and he seemed after a time to kill himself, I was much surprised, and began to investigate his mouth, to see if he did not have poison fangs after all. He, as they all do, had turned himself on his back and was lying rigid in that position. In the course of my investigation I turned him over, "right side up," again. He was playing dead so earnestly that he could not lie in so life-like a position, but immediately turned himself on his back again. Then, of course, I knew that a snake which was *too dead* to stay in the position in which I placed him, was *too alive* to be very badly hurt. I determined to watch him. Accordingly I removed him to a smooth, clear place and then withdrew to a little distance to quietly watch developments. In about fifteen minutes the snake cautiously raised his head and two or three inches of his body and looked around. If he saw me he failed to recognize me, and in a few seconds had turned himself over and was making off. When I advanced quickly towards him he redoubled his efforts to escape, but was easily captured. He did not, at that time, again "play 'possum."

Often since then I have watched them go through this pretended suicide. Usually when becoming active again, they behave like the one just described; but occasionally when they find themselves overtaken as they are making off, they will again at once feign death. Sometimes while "playing dead," if one is sharply pricked with a needle or otherwise acutely stimulated, he will promptly resume his interest in surrounding things and either show fight or try to escape.

Occasionally when I have spoken to friends about this matter and they have shown a disposition to regard my statements as "snake stories," in the popular sense of that expression, I have been fortunate enough to get hold of a spread-head and show them what I had before described to them.

It is usually easy to provoke a *Heterodon, niger, H. platyrhinus*, or *H. simus* into feigning death by striking him with small twigs or a good bunch of broom straw, or by a little brisk handling. I wish some one else would examine these snakes with reference to this habit and report his conclusions. I think "fainting from fear" is shown to be wrong by the snake's refusing to stay in any other position than "flat on his back."

Recently while conversing with a friend about this matter, he suggested that perhaps the rattlesnakes which are so often provoked into biting themselves and then seeming to die, were also acting a deceptive part in order to escape. This seems more probable as one noted experimenter, Dr. S. Weir Mitchell, says that the injection of rattlesnake's venom into the snake's own circulation does not appear to cause any special inconvenience to the snake.

I would be glad to get some further information on this subject. J. W. KILPATRICK.

Fayette, Mo., Sept. 23, 1893.

ELECTRICAL COOKING.

THE elaborate argument of R. A. F., in a recent number of *Science*, in favor of the economy of cooking by electricity will hardly convince the practical man. While witnessing the interesting exhibit of electrical heating apparatus at the World's Fair I asked the attendant in charge "What current is required for your flatirons?" "Four amperes and one hundred volts," he replied. "Eight cents an hour," I said to myself, "at ordinary lighting prices. That is far more than the household coal costs for all purposes." Even at half the lighting rates such heating costs too much for ordinary use.

W. C. S.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale.—A collection of fossil Rhinoceros bones (Aphelops fossiger Cope.) from the Loup Fork Tertiary, including all the bones of one fore and one hind leg, the pelvis, representative vertebrae and ribs, and a nearly complete skull, with complete lower jaws. All the bones of the limbs are perfect. Price $250. Address Dept. of Paleontology, University of Kansas, Lawrence.

For Exchange.—Books and pamphlets on geology, ornithology, conchology, and entomology. State what line and I will send list. I want Odonota from any locality, and literature on this group. M. J. Elrod, Ill. Wes. Univ., Bloomington, Ill.

For Sale.—The remains of three individuals, one young and two adult, of Elephas Americanus found in Jasper Co., Mo. The remains comprise most of the skeletons, and comparatively little restoration would have to be done. The bones are in a good state of preservation and have not been worked out. For terms and further information address E. O. Hovey, 239 Center St., New Haven, Conn.

Bird skins scientifically prepared, with full data, in exchange for species from the U. S. not in my collection. Horace G. Smith, 2918 Lafayette St., Denver, Colo.

For Sale.—Holmes' System of Surgery by Packard. 3 vols., calf, 1881, new, for $15.00 (regular price, $21.00). Hares's System of Practical Therapeutics. 3 vols., calf, 1891, new, for $12.90. (regular price, $18.00.) Dr. Ashmead, 45 Macdougal St., New York.

For Sale.—"Die Modernen Theorien der Chemie," by Lothar Meyer and Bernthsen's "Organic Chemistry," both well bound and unused. Address L. M. Otis, 214 S. 37th St., Philadelphia.

Wants.

WANTED.—A copy of Mascart & Joubert's Lessons in Electricity and Magnetism, Vol. I. Address R. W. Clawson, Vanderbilt University, Nashville, Tennessee.

CHEMIST.—Graduate of a polytechnical school, and studied photographic chemistry in Germany and Austria. Situation teaching or in analytical or experimental laboratory. M. B. Punnett, Rochester, N. Y.

WANTED.—A recent college graduate to assist in editorial work on Science. Those seeking large emoluments need not apply. N. D. C. Hodges, 874 Broadway, New York.

A GRADUATE in medicine, experienced, will prepare or revise scientific and medical manuscript for publication, read proof, compile bibliographies, &c. Will also consult New York libraries for persons out of town wishing references to rare works. Address M. D., 104 Cambridge Place, Brooklyn, N. Y.

FOR SALE.—Volumes V. and VI. of the "Explorations for a Railroad Route from the Mississippi River to the Pacific," 1857, half calf, in good condition; a large number of colored and uncolored plates of Mammals, Birds, Fish, etc., etc. On receipt of $7.00 will send to any ordinary point in the U. S., express paid. These volumes are now rare. Address Dr. Shufeldt, Takoma Park, Dist. of Columbia.

A YOUNG woman who has been an assistant for a literary and scientific man desires a similar position. Is an experienced and accurate stenographer and typewriter, thoroughly educated, and sufficiently familiar with literary work to write, independent of dictation. Has some knowledge of the Spanish language. Will go to any part of the United States. Address, Box 147, Ravenna, Ohio